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GROUP 2600

**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 09/697,703
Filing Date: October 27, 2000
Appellant(s): TAYLOR, MICHAEL G.

Michael R. Cammarata
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 6/30/04.

(1) Real Party in Interest

A statement identifying the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

A statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief.

(3) Status of Claims

The statement of the status of the claims contained in the brief is incorrect. A correct statement of the status of the claims is as follows: Claims 1-18 and 21-23 are rejected while Claims 19 and 20 are allowed.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Invention

The summary of invention contained in the brief is correct.

(6) Issues

The appellant's statement of the issues in the brief is correct.

(7) Grouping of Claims

Appellant's brief includes a statement that claims 1-18 and 21-23 do not stand or fall together and provides reasons as set forth in 37 CFR 1.192(c)(7) and (c)(8).

Appellant's brief includes a statement that claims 19-20 do not stand or fall together and provides reasons as set forth in 37 CFR 1.192(c)(7) and (c)(8).

(8) Claims Appealed

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) Prior Art of Record

5,793,511	BULOW	8/1998
6,130,766	CAO	10/2000
5,930,414	FISHMAN	7/1999
6,134,033	BERGANO et al	10/2000

(10) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-4, 9, 12-16, and 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bulow (U.S. Patent No. 5,793,511) in view of Cao (U.S. Patent No. 6,130,766).

Regarding Claim 1 Bulow teaches a polarization mode dispersion compensating apparatus, comprising: a polarization mode dispersion compensator (reference numeral 1.7 in Figure 1) optically coupled to an input port and receiving an input optical signal having polarization mode dispersion (column 1 lines 9-10), said polarization mode dispersion compensator having a variable polarization mode dispersion (e.g. polarization controller 1.7 of Figure 1 variably changes the polarization of the input signals); a polarimeter (reference numeral 1.4, 1.5, 1.8, 1.9, 1.2 in Figure 1) optically coupled to the output of said polarization mode dispersion compensator and outputting an electrical signal (reference numeral 1.15 in Figure 1) representing polarization states of the optical signal; and a controller (reference numeral 1.3 in Figure 1) operatively coupled to said polarimeter and said polarization mode compensator, said controller receiving the electrical signal from said polarimeter (reference numeral 1.2 in Figure 1) ; said controller controlling said polarization mode dispersion compensator according to the electrical signal to compensate for the polarization mode dispersion of the input optical signal (column 3 lines 17-28). Bulow differs from the claimed invention in that Bulow fails to specifically teach that the input optical signal has a wavelength dither. However, dithering of an optical signal is very well known in the art. Cao, in the same field of endeavor, teaches that wavelength dithering of an input signal is very well known in the art (column 5 lines 22-44). One skilled in the art would have been motivated to dither the wavelength of an input signal in order to generate an electrical dithering output control signal to a laser. Therefore, it would have been obvious to one skilled in the art at the time the invention was made to have dithered the wavelength of an input signal.

Regarding Claim 2, the combination of Bulow and Cao teaches or suggests the polarization mode dispersion compensating apparatus according to claim 1, further comprising; a signal source (reference numeral 32 in Figure 1 of Cao) for generating the input optical signal with the wavelength dither, wherein the input optical signal is transmitted across optical fiber (reference numeral 1.18 in Figure 1 of Bulow) and/or components that cause the input signal to have the polarization mode dispersion.

Regarding Claims 3 and 12-14, Bulow teaches said polarimeter including: a first polarizer (reference numeral A1 in Figure 6) optically coupled to said polarization mode dispersion compensator (reference numeral 6.1 in Figure 6), said first polarizer plane polarizing an optical signal output from said polarization mode dispersion compensator at first polarization angle (column 5 lines 40-43); a second polarizer (reference numeral A2 in Figure 6) optically coupled to said polarization mode dispersion compensator, said second polarizer plane polarizing an optical signal output from said polarization mode dispersion compensator at a second angle different than the first angle (column 5 lines 40-43); a third polarizer (reference numeral An in Figure 6) optically coupled to said polarization mode dispersion compensator; a first photodetector (reference numeral D1 in Figure 5) optically coupled to said first polarizer and outputting a first detection signal (reference numeral I1 in Figure 5); a second photodetector (reference numeral D2 in Figure 5) optically coupled to said second polarizer and outputting a second detection signal (reference numeral I2 in Figure 5); and a third photodetector (reference numeral DN in Figure 5) optically coupled to said third polarizer and outputting a third detection signal (reference numeral IN in Figure 5). Bulow differs from the claimed invention in that Bulow fails to specifically teach that said third polarizer circularly polarizing an optical signal

output from said polarization mode dispersion compensator. However, being that Bulow teaches that each of the polarizers produces signals with different polarizations (column 5 lines 40-43), one skilled in the art would clearly have recognized that circular polarization could have been included. Circular polarization of a signal is very well known in the art. One skilled in the art would have been motivated to have circularly polarized the optical signal output by the polarization mode dispersion compensator via the third polarizer taught by Bulow in order to have anticipated the polarization mode dispersion for circularly polarized signals. Therefore, it would have been obvious to one skilled in the art at the time the invention was made to have circularly polarized the optical signal output by the polarization mode dispersion compensator via the third polarizer taught by Bulow.

Regarding Claims 4 and 15, Bulow teaches that said controller controls said polarization mode dispersion compensator so as to minimize a sum of the squares of the first, second and third detection signals to compensate for the polarization mode dispersion of the input optical signal (e.g. minimizing method, column 3 line 66 – column 4 line 7).

Regarding Claims 9 and 16, the combination of Bulow and Cao differs from the claimed invention in that it fails to specifically teach that said controller utilizes an adaptive learning algorithm to further minimize the sum of the squares of the first, second and third detection signals and further compensate for the polarization mode dispersion of the input optical signal. However, such learning algorithms are well known in the art. One skilled in the art would have been motivated used a learning algorithm in order to consistently and precisely reduce the polarization mode dispersion of the input signals. Therefore, it would have been obvious to one

skilled in the art at the time the invention was made to have used a controller with an adaptive learning algorithm

Regarding claims 21-23, Bulow teaches that the polarimeter detects polarization states of the output of the polarization mode dispersion compensator in at least three degrees of freedom (as indicated by the use of three different splitters A1-AN in Figure 5).

3. Claims 5-9, 17, and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bulow in view of Cao and Fishman (U.S. Patent No. 5,930,414).

Regarding Claims 5 and 17, the combination of Bulow and Cao teaches a polarization controller (reference numeral 1.7 in Figure 1 of Bulow) optically coupled to the input port and receiving the input optical signal, but differs from the claimed invention in that it fails to specifically teach a first birefringent component optically coupled to said polarization controller; a variable retarder optically coupled to said first birefringent component; and a second birefringent component optically coupled to said variable retarder; said controller operatively coupled to said polarimeter, said variable retarder and said polarization controller; said controller controlling said variable retarder and said polarization controller according to the electrical signal to compensate for the polarization mode dispersion of the input signal. However, Bulow teaches an integrated version of the claimed invention wherein a birefringent element and a variable retarder within the polarization controller are controlled by a controller according to an electrical signal to compensate for the polarization mode dispersion of the input signal, the controller being coupled to the variable retarder, the polarization controller, and the polarimeter (column 3 lines 13-34). Furthermore, Fishman, in the same field of endeavor, teaches a first birefringent component (reference numeral 435 in Figure 4) optically coupled to said

polarization controller (reference numeral 430 in Figure 4); a variable retarder (reference numeral 440 in Figure 4) optically coupled to said first birefringent component; and a second birefringent component (reference numeral 445 in Figure 4) optically coupled to said variable retarder; said controller (reference numeral 470 in Figure 4) operatively coupled to said polarimeter (reference numeral 455 in Figure 4), said variable retarder and said polarization controller; said controller controlling said variable retarder and said polarization controller according to the electrical signal to compensate for the polarization mode dispersion of the input signal (abstract). Clearly, the teachings of Bulow, Cao, and Fishman would have suggested to one skilled in the art that either an integrated version (taught by Bulow) or a modular version (taught by Fishman) could have been used as the polarization mode compensator. Therefore, it would have been obvious to one skilled in the art at the time the invention was made to have used the modular structure of the polarization mode dispersion compensator taught by Fishman in the device of the combination of Bulow and Cao.

Regarding Claim 6, the combination of Bulow, Cao, and Fishman teach or suggest a first polarizer (reference numeral A1 in Figure 6 of Bulow) optically coupled to said second birefringent component (reference numeral 445 in Figure 4 of Fishman), said first polarizer plane polarizing an optical signal output from said second birefringent component at an angle parallel to an optic axis (e.g. polarization selected by one skilled in the art for the polarizer taught by Bulow in Figure 6) ; a second polarizer (reference numeral A2 in Figure 6 of Bulow) optically coupled to said second birefringent component, said second polarizer plane polarizing an optical signal output from said second birefringent component at an angle not parallel to the optic axis (e.g. polarization selected by one skilled in the art for the polarizer taught by Bulow in Figure 6);

a third polarizer (reference numeral AN in Figure 6 of Bulow) optically coupled to said second birefringent component, said third polarizer plane circularly polarizing an optical signal output from said second birefringent component (e.g. polarization selected by one skilled in the art for the polarizer taught by Bulow in Figure 6); a first photodetector (reference numeral D1 in Figure 5 of Bulow) optically coupled to said first polarizer and outputting a first detection signal; a second photodetector (reference numeral D2 in Figure 6 of Bulow) optically coupled to said second polarizer and outputting a second detection signal; and a third photodetector (reference numeral DN in Figure 6 of Bulow) optically coupled to said third polarizer and outputting a third detection signal.

Regarding Claims 7 and 18, the combination of Bulow, Cao, and Fishman teaches or suggests that said controller controls said polarization mode dispersion compensator so as to minimize a sum of the squares of the first, second and third detection signals to compensate for the polarization mode dispersion of the input optical signal (e.g. minimizing method, column 3 line 66 – column 4 line 7 of Bulow).

Regarding Claim 8, Bulow teaches that said polarization controller and said retarder are integrated electrooptic waveguide devices or liquid crystal components (column 3 lines 22-34).

4. Claims 10 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bulow in view of Cao and Bergano (U.S. Patent No. 6,134,033).

Regarding Claim 10, the combination of Bulow and Cao differs from the claimed invention in that it fails to specifically teach a plurality of optical transmitters, each emitting a corresponding one of a plurality of optical signals, each of the plurality of optical signals being at a respective one of a plurality of wavelengths and having a respective wavelength dither; an

optical combiner having a plurality of inputs, each of which being coupled to a respective one of said plurality of optical transmitters, and an output supplying the plurality of optical signals to a first end portion of an optical communication path; an optical demultiplexer having an input configured to be coupled to a second end portion of the optical communication path, and a plurality of outputs, each of the plurality of outputs of said optical demultiplexer supplying a respective one of the plurality of optical signals; a plurality of polarization mode dispersion compensating apparatuses according to claim 1, each of which being coupled to a respective one of the plurality of outputs of said optical demultiplexer; a plurality of optical receivers, each of which being coupled to a respective one of the plurality of outputs of said polarization mode compensating apparatuses. However, multiplexing a plurality of signals via an optical combiner, transmitting the combined optical wavelengths via fibers and amplifiers to a receiving end, the receiving end comprising a demultiplexer and dispersion compensators, is very well known in the art. Bergano teaches such a multiplexed communication system including dispersion compensation at the receiver. One skilled in the art would clearly have recognized that it would have been possible to use the polarization mode compensators taught by the combination of Bulow and Cao as the dispersion compensators in the multiplex communication device of Bergano. Furthermore, Bulow suggests using the polarization mode dispersion compensators in a transmitter and receiver system (column 1 lines 10-15, column 2 lines 4-19). One skilled in the art would have been motivated to use the compensators of the combination of Bulow and Cao in the device of Bergano in order to have the ability to compensate for polarization mode dispersion. Therefore, it would have been obvious to one skilled in the art at the time the

invention was made to have used the compensators taught by the combination of Bulow and Cao as the dispersion compensators taught by Bergano.

Regarding Claim 11, the combination of references teach or suggest a plurality of optical amplification devices arranged in series along the optical communication path (column 4 lines 61-64 of Bergano).

(11) Response to Argument

In response to the applicant's **A.1 Bulow Cannot Teach or Suggest the Polarization mode Dispersion Compensator as Claimed,** the examiner will first establish that polarization controller 1.7 of Bulow is indeed a polarization mode dispersion compensator.

First, Bulow specifically discloses (column 2 lines 58-60):

"*The electrical signal components S_{-}, S_{+} come from the optical signal S, which may be distorted by the* (sic) *polarization mode dispersion PMD;*"

Next, Bulow discloses (column 3 lines 22-28):

"*The (electrically controllable) optical polarization controller 1.7 is e.g. an arrangement of two adjacent plates to which a fiber length is attached. Rotating the plates exerts a torsional force on the fiber length, which can be influenced by the control signals P1, P2.* ***This allows any desired adjustment of the polarization of the optical signal S.***" Emphasis added.

Finally, Bulow discloses (column 4 lines 59-65):

"*But a small error rate also means that the* ***optical polarization controller 1.7*** *depicted in FIG. 1 has been* ***properly adjusted*** *by the control signals P1, P2. If the polarization of the optical signal changes, the optical polarization controller 1.7 can be* ***adaptively compensated*** *by varying the control signals P1, P2 and by minimizing the error rate Y_{-}).*"

As such, it is clear that an optical signal suffering from polarization mode dispersion is input to the polarization mode dispersion compensator of Bulow (reference numeral 1.7 in Figure 1) and the distorted signal is compensated by polarization adjustments made to the polarization mode dispersion compensator until a small error rate is achieved. Therefore, polarization controller 1.7 of Bulow is a polarization mode dispersion compensator in that it compensates a polarization mode dispersion distorted signal in order to achieve a small error rate.

Having established that the polarization controller of Bulow is a polarization mode dispersion compensator, the examiner will next address the applicant's contention that Bulow fails to specifically teach that an output of the polarization mode dispersion compensator serves as an output of the polarization mode dispersion compensating apparatus. First, it should be noted that the output signal D is a direct derivative of the optical signal output from the polarization mode dispersion compensator. Bulow specifically discloses (column 3 lines 4-7) that,

"*The equalizing circuit 1.2 has an output 1.10 for a data signal D derived from the optical signal S,...*"

The output signal D originates from signals S_-, S_+ which originate from a split optical signal S output from polarization mode dispersion compensator 1.7 in Figure 1. Therefore, it is clear that when given the broadest reasonable interpretation, the output of the polarization mode dispersion compensator serves as an output of the polarization mode dispersion compensating apparatus as claimed.

In response to the applicant's **<u>A.2 Examiner's "Derivative" Test Unreasonable,</u>** Bulow explicitly discloses (column 3 lines 4-7) that,

"The equalizing circuit 1.2 has an output 1.10 for a data signal D derived from the optical signal S, ..."

Therefore, it is not clear how the examiner has strained or unreasonably interpreted Bulow in concluding that the signal D is derived from the signal S since Bulow explicitly discloses as much.

Next, in **A.3 Bulow's Output D Cannot Teach the Output As Claimed** the applicant argues that the polarimeter of Bulow is not optically coupled to the output of the polarization mode dispersion compensator, and therefore, Bulow cannot meet the limitations of the claimed invention. However, the opposite is true. As noted in the office action, Bulow teaches a polarimeter comprising elements 1.4, 1.5, 1.8, 1.9, 1.2 in Figure 1. The output of the polarization mode dispersion compensator 1.7 is an optical signal that is split and input to the polarimeter. As such, it is clear that the polarimeter is optically coupled to the polarization mode dispersion compensator.

Next, the applicant argues that the output of the entire apparatus is optical. However, an optical output is not clearly claimed. Upon close review of the language of claim 1, one will notice that at no time does the applicant claim an optical output of the entire polarization mode dispersion compensating apparatus. In fact, the claim language does not give a clear indication of the composition of the output signal of the polarization mode dispersion compensating apparatus. Furthermore, the claim language fails to specifically define a positional relationship between the polarimeter and the polarization mode dispersion compensator that allows for only an optical output. Instead, the claim language simply recites that the two elements are optically coupled and that the polarimeter outputs an electrical signal. As such, a broad interpretation of

the claim language could lead one to conclude that the electrical signal output from the polarimeter is also the output of the entire polarization mode dispersion compensating apparatus as taught by Bulow. Although the applicant is free to infer without claiming that the output of the polarization mode dispersion compensator is an optical signal, the examiner does not have the luxury of assuming that as much is true. Instead, the examiner is bound by broadest reasonable interpretation of the claims, which in this case, reads directly on Bulow. If the applicant intends the output of the polarization mode dispersion compensating apparatus to be optical, then as much should be explicitly claimed to distinguish the claimed invention from that of Bulow.

Regarding the applicant's arguments in **A.4 Bulow Cannot Teach or Suggest the Polarimeter as Claimed**, the examiner in the office action noted that Bulow teaches a polarimeter comprising elements 1.4, 1.5, 1.8, 1.9, 1.2 in Figure 1, the output of which is an electrical signal Q provided to controller 1.3 for controlling the polarization mode dispersion compensator. The examiner has concluded that the signal Q represents the polarization states of the output of the polarization mode dispersion compensator since the output of the polarization mode dispersion compensator is fed through polarizers 1.4 and 1.5 thereby producing polarization states of the output of the polarization mode dispersion compensator that are then converted to electrical signals S_{-} S_{+} by detectors 1.8 and 1.9 and fed to equalizing circuit 1.2 where they are converted to signals $Y_{\pm}$ and $Z_{\pm}$ and fed to controller 2.5 which produces Q therefrom. Clearly, the electrical signal Q represents the polarization states of the output of the polarization mode dispersion compensator in that it is derived from the polarization states received from the polarization mode dispersion compensator. Furthermore, throughout Bulow

Q is referred to as a "quality signal" in which the error rate refers to the polarization effects on the signal caused by the polarization mode dispersion. As such, it is clear that Q represents the polarization states of the signals output from the polarization mode dispersion compensator since it is the effects of this polarization mode dispersion that the system seeks to compensate. In other words, the quality signal Q takes into account the polarization states of the output of the polarization mode dispersion compensator and provides this information to the controller 1.3 which in turn makes adjustments to the polarization mode dispersion compensator to produce better polarization states thereby resulting in less errors.

Regarding applicant's argument **A.5 Bulow Cannot Teach or Suggest the Controller as Claimed**, Figure 1 of Bulow shows that the output "Q" 1.15 of the polarimeter is fed to the controller 1.3 for controlling the polarization mode dispersion compensator according to the polarization states detected in the polarimeter. The striking resemblance of applicant's polarimeter/controller of Figure 3 and Bulow's Figure 1 should be noted.

Regarding applicant's argument **A.6 Bulow and Cao Teach Away from Each Other...**, the examiner has only relied on Cao to show that including a wavelength dither on an optical signal is well known in the art. Furthermore, the fact that Cao also teaches a polarization mode dispersion compensating system only serves to bolster the examiner's position that it would have been obvious to one skilled in the art to include a wavelength dither on the optical signal input to the polarization mode dispersion compensating system of Bulow, since both teach a polarization mode dispersion compensating system. The fact that Bulow teaches polarization mode dispersion compensation in the electrical domain bears no relevance to the optical signal input to Bulow's system or how that optical signal is formed. Adding a wavelength dither

signal to the optical signal of Bulow as taught by Cao would in no way render the electrical polarization mode dispersion compensating system of Bulow inoperative or unsatisfactory since the device of Bulow does not care what type of optical signal it receives. The device of Bulow is simply concerned with polarization mode dispersion compensation of that optical signal and not how it was formed. Once again, the examiner has only relied on Cao to show that including a wavelength dither in an optical signal is well known in the art, and further well known in the art of polarization mode dispersion compensating systems.

Applicant's B arguments have been considered and have proven persuasive. As such, the examiner concludes that claims 19 and 20 are allowable.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Agustin Bello
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AB
September 20, 2004

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